

# **Localization of Transit-Oriented Development around China's High-Speed Rail Stations: The Case of Jinan**

**A Thesis Presented to the Faculty of Architecture and Planning  
COLUMBIA UNIVERSITY**

**In Partial Fulfillment  
of the Requirements for the Degree  
Master of Science in Urban Planning**

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May 2015**

## **ABSTRACT**

China's massive investment in urban rail presents opportunities for Transit-Oriented Development (TOD) around High-Speed Rail (HSR) stations. Transit-Oriented Development is regarded as an alternative growth model for urban sprawl, which reduces auto-trips, encourages transit usage and forms attractive neighborhoods. It is highly desirable because of the traffic congestion and air pollution in most Chinese cities. This thesis studies the challenges of integrating land use and transportation around HSR stations by analyzing Jinan West Station District. Evidence shows that TOD plans around HSR are struggling and the benefit of HSR is exaggerated. Housing prices fall after a rise. Speculation and low tenant quality causes the place to be deserted. Over a hundred plans were made for the West Station District but the market is not responding. It becomes a typical example of a public action that doesn't generate long-lasting market response.

# Table of Contents

<b>INTRODUCTION .....</b>	<b>1</b>
<b>LITERATURE REVIEW .....</b>	<b>2</b>
Transit-Oriented Development Concept and Principles .....	2
Benefits of TOD .....	3
China's Practice of TOD .....	6
Implications for This Study .....	9
<b>DATA AND METHODOLOGY .....</b>	<b>9</b>
<b>GOALS OF JINAN WEST STATION DISTRICT TOD PLAN .....</b>	<b>10</b>
To Build A New Town .....	10
To Seize Economic Opportunity .....	10
To Encourage Walking and the Use of Transit .....	13
<b>PLANNING SEQUENCING .....</b>	<b>16</b>
<b>PROBLEMS .....</b>	<b>18</b>
Growing GDP and Dropping Housing Prices .....	18
Inconvenient Public Transportation .....	20
Low-income Tenants and Absence of Retail and Schools .....	21
<b>URBAN DESIGN THAT DISCOURAGES WALKING .....</b>	<b>21</b>
<b>REASONS .....</b>	<b>25</b>
<b>SPECULATION .....</b>	<b>25</b>
Not for Daily Commute .....	26
Land Use Policy .....	27
Closed-off Management .....	27
<b>CONCLUSIONS .....</b>	<b>29</b>
<b>REFERENCES .....</b>	<b>30</b>

## INTRODUCTION

China's current investment in transit is massive – 3,000 km of urban rail will be in operation in 2015, 6,000 km in 2020 (World Bank, 2013). Transit-Oriented Development concepts and practices already emerged across China. In August 2014, the General Office of the State Council published the “opinion on supporting the implementation of integrated land and rail development”. Many cities in China adopted TOD planning around transit stations including HSR stations. Many problems and challenges arose with TOD plans. For example, Mu and Jong (2012) found that Within the planned TOD communities, affluent homeowners who value amenities and pursue to live near transit most likely will still travel by car, while those low-income earners who are less likely to own cars and more dependent on public transport are often excluded from living near stations and thus have problematic accessibility to transit services.

Jinan West HSR Station is one of the five terminals for the Beijing-Shanghai HSR, which allegedly gives Jinan an unparalleled development opportunity. The West HSR station will be a regional center, and the city is building a new town around it with a lot of public investment. Large developers are also investing billions of dollars to build apartments, offices, retail, hotels as well as kindergartens and schools. Over 100 specific plans have been made for the West Station District regarding industry development, urban design, infrastructure, comprehensive transportation system and ecological system based on the West Station District control plan and Jinan's overall plan. But in 2014 when the station opened for three years, housing price dropped and industries didn't move in. The place looks like a ghost town at night. The benefit of HSR is exaggerated since the area is not integrated with the city's economy and the market is not responding to the TOD plan. It is important to analyze the problems and rethink the relation of regional transit and land use at this point. Analysis shows the problems in the TOD planning. Some planning are not responding to local needs and some are common problems across China.

## **LITERATURE REVIEW**

### **Transit-Oriented Development Concept and Principles**

Bernick and Cervero(1997) describes transit village as a compact, mixed-use community centered around a transit station that by design, invites residents, workers, and shoppers to drive their car less and ride mass transit more.

Transit-oriented development does not mean totally abandoning the use of cars. Even with an ambition 40% non-auto mode split, 60% of all trips will continue to be via autos. The land use patterns in TODs, as well as their internal street systems, must plan for on-going auto use. Adequate auto access from arterials and freeways, as well as frequent transit service, will also be an important locational consideration for the more intensive, employment-oriented TODs. Not all transit stops will be TODs; some stops will be developed as park-and-ride lots (Calthorpe, 1993).

Urban TOD, defined as TOD located directly on the trunk line transit network should be developed with high commercial intensities, job clusters, and moderate to high residential densities. The preferred mix of land uses, by percent of land area within a TOD is 10%-15% public, 10%-40% core/employment and 50%-80% housing (Calthorpe, 1993). Streets should converge at common destinations, such as transit stops, core commercial areas, and parks. They should allow autos, bikes, and pedestrians to travel on small local streets to any location in the TOD without crossing or following an arterial. On-street pedestrian and bicycle paths should be provided to allow residents to walk to all local destinations, rather than segregated off-street paths(Calthorpe, 1993).

Campoli (2012) summarized 5Ds and a P to measure the success of compact development. Five Ds are diversity, density, distance to transit, design and destination accessibility, and P is parking. Urban designers should focus on two strategies: connecting streets will shorten trips; and making them pedestrian and bicycle-friendly which improve the quality of the journey.

Creating an active pedestrian environment is a core principle and an essential characteristic of well planned TODs. For TOD designers that means creating as many active street edges (lining streets with people oriented uses) as possible. Parking influences the use of street edge (Arrington and Cervero, 2008).

## **Benefits of TOD**

Transit-Oriented Development— particularly pre-1950s TOD—is so prevalent in places with century- old transit systems like New York, Boston, Massachusetts, and Chicago, Illinois. Spillover development into neighborhoods adjacent to transit stations demonstrates the mutually reinforcing relationship (often taken for granted) between transit service and urban development. Low population density (5–19 per hectare in this corridor) did not prevent the success of the rail extension in Australia, much of it being due to park-and-ride (Olaru etc., 2010). Bus Rapid Transit projects are modeled on bus transit in Curitiba, Brazil, where a network of local and express buses has encouraged high-density residential districts along key transit corridors (Cervero, 1998).

Improvement of transportation networks reduces interaction costs, increases the overall competitiveness of the system and allows for more specialization such that economies of scale and specialization benefits can be utilized. Hence, we should expect that production and other economic activities can be carried out more efficiently as the quality and capacity of a region's transportation networks increase (Forslund and Johansson, 1995). The benefits of high-speed rail include driving national and regional growth, promoting the flow of knowledge, money, people and technology, facilitating the industry integration and upgrade, and creating jobs, expenditure, and urbanization of new cities. Many cities in Japan benefited greatly from being the transportation center such as Yokohama, Chiba, Kisarazu etc.. They become the center of public service, technology innovation, market transaction, skilled labor, international communication and so on.

Transit-based housing, some contend, promote a number of public-policy goals (Calthorpe, 1993; Cervero, 1993; Bernick and Cervero, 1997). First of all, increased transit ridership enhances urban mobility and relieves peak-hour traffic congestion. The trip-reduction effects are thought to come from three major sources (Arrington and Cervero, 2008; 1) residential self-selection: for lifestyle reasons people consciously seek out housing near major transit stops for the very reason they want to regularly take transit to work and other destinations; studies in California suggest as much as 40% of the mode choice decision to commute via transit can be attribute to the self-selection

phenomenon (Cervero, 2007; 2) the presence of in-neighborhood retail sited between residences and stations that promote rail-pedestrian trip-chaining; 3) car-shedding (i.e., the tendency to reduce car-ownership when residing in efficient, transit-served locations (Holtzclaw, et al., 2002).

Other benefits assigned to transit-based housing included increases in the supply of affordable units and improved air quality (Cervero and Duncan, 2002). Affordable housing around TOD was the main pull motivation for choosing Wellard and Cockburn Central precincts in Australia when households looked for another dwelling (Olaru etc., 2010). Mixed-income TOD offers additional benefits of truly affordable housing, stabilizes transit ridership, broadens access to opportunity and relieves gentrification. Affordability is typically understood as the cost of housing, but the interaction between housing and transportation costs provides a more meaningful measure. Transportation is the second highest expenditure after housing in most regions (transportation costs are higher than housing costs for working families in 17 of 28 metro regions). The Center for Transit-Oriented Development created a new index of affordability that combines housing and transportation costs for a neighborhood or a region, and divides it by income. The Low Income Housing Tax Credit program (LIHTC) is the greatest single source of funding for affordable housing at both the state and regional levels. Twenty-eight states already give preference to require proximity to transit as one criteria(The Center for Transit-Oriented Development).

Some argue that despite the explosion of empirical studies in recent decades, it is still premature to draw any conclusions about the impacts of built environments on travel behavior. The role of household structure and individual characteristics explain the diversity of travel and location decisions (Circella et al., 2008; Kim et al., 2007; Kitamura et al., 1997; Meurs and Haaijer, 2001; Timmermans et al., 2002; Weber and Kwan, 2003; Schwanen and Mokhtarian, 2005). Households may choose residential locations that fit in with their travel needs. This is known as residential self-selection.

Transportation now represents 60% of China's petroleum consumption, and is its fastest growing sector. As the country's urban patterns reinforce auto use through more freeways, large arterials and superblocks; walking, biking and transit are declining. The congestion, air quality, and greenhouse gas impacts of such a shift are massive. Studies in Jinan show that there is a fivefold

increase in household vehicle kilometers traveled (VKT) between a mixed-use traditional street grid neighborhood and a newer single-use superblock configuration. The current pattern of development in China is the superblock model. Based on a network of wide arterial streets, it features large development blocks, often 500 meters by 500 meters in size. The superblock model attempts to move cars efficiently with ever-wider streets, often at the expense of pedestrian safety and bike movement. To counter the impacts of wider streets, building setbacks further separate uses and distance pedestrians. This combination of factors hinders pedestrian convenience and bike safety, which in turn affects retail activity and transit usage (Jinan New East Station District Plan, 2014).

Extensive studies of Jinan's four neighborhood types found the quantitative relationship between urban design and energy consumption (see Table 1). Figure 1 shows both the total and the per dimension (i.e., transportation, operational, embodied) energy consumption per household of each neighborhood type. Households in the high-rise superblock typology consume much more energy than the others-up to twice as much, and consume on average 2-3 times more transportation related energy than those in other neighborhood types. Although Chinese urban households still consume a relatively low level of transport energy compared to those in the developed countries of the

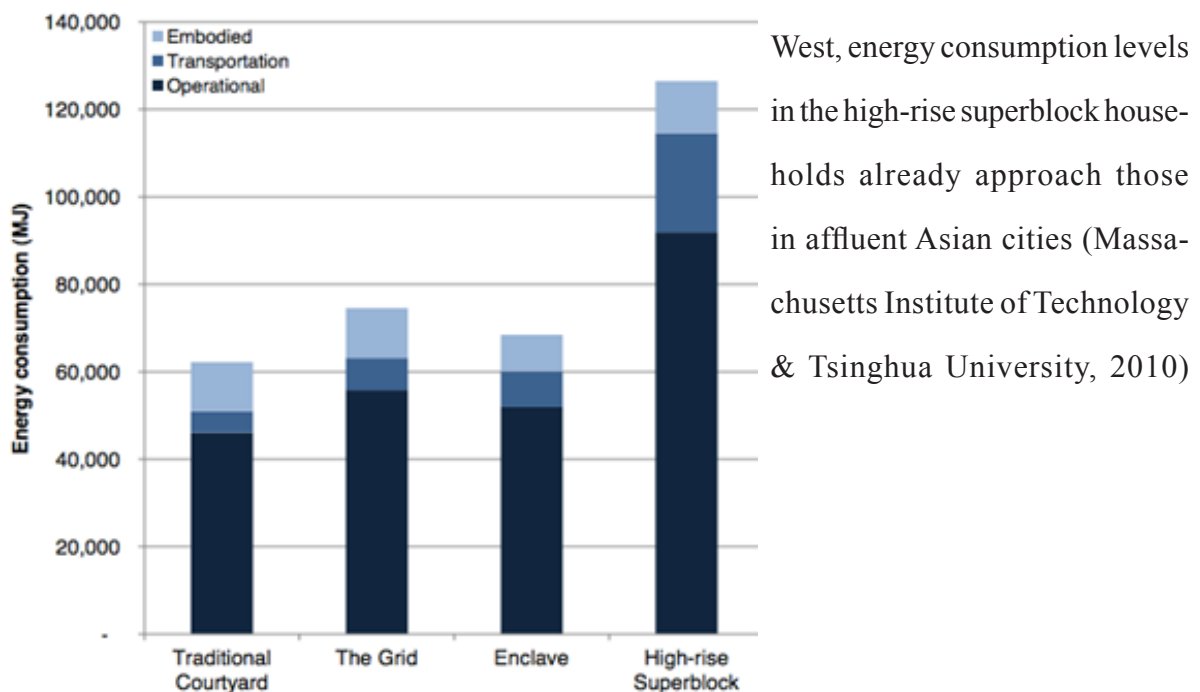


Figure 1 Energy Consumption by Neighborhood Type in Jinan



Table 1 Comparison of Jinan's 4 Neighborhood Types

Time	Neighborhood Type	Features	Typical Case
Pre 1910	Traditional settlement	Low-rise, high-density courtyard housing organized on Hutongs with a central commercial street.	Zhang-Jia Village
1920	Urban grid	Conventional streets and blocks with mixed uses and building types. It retains a human scale of streets and spaces and a lively, diverse character	Old Commercial Center
1980	Enclaves of low-rise slabs	Rows of repetitive, 6-7 story walk-up apartments developed mainly by the government or danweis (work units) to house working class families in China's first wave of urbanization beginning in the 1970s. Over time, these simple forms have been adapted to mixed use.	Dong-Cang
2000	Tower-in-park	Mainly single-use residential districts consisting of widely spaced 20-30 story towers with surface or underground parking. Many are gated communities highly dependent on the car, although it may include a shopping center on the periphery	Sunshine 100

### China's Practice of TOD

Transit-Oriented Development concepts and practices already emerged across China. Take Luohu Hub of Shenzhen, where daily peak-hour traffic volume can reach 600,000 people per day, as an example. Parking was restricted in this hub so that more people would walk, bicycle and use

transit instead of driving (World Bank Meeting, 2013). The suburbanization of large Chinese cities has placed many residents in locations that are far less accessible than their prior residences, requiring motorized travel (Cervero and Day, 2009; Mu and Jong, 2012). Hangzhou's East Station's length of block is 100-200m. It is developed around a modern integrated transport hub, and the region is focusing on high level business, commerce and entertainment, tourism and residential. Beijing's rail transit expansion is accompanied by a real estate boom. Yet there is a lack of planning and development between the two, although they may be spatially adjacent. Housing projects followed the rail transit network, but jobs and services did not. Such a job-housing unbalanced land use is shown in traffic outcomes. In the morning peak, the ratio between the inbound and outbound boardings range from 4 in Huilongguan to as high as 9 in the Longze Station because most of the residents still work in the inner city of Beijing. These two stations serve the northern outer suburb of Beijing. In the late 1990s before Line 13 was planned and constructed, the area was mostly green. By 2003, more than 30 residential projects were completed in the area. Affordable and mixed-income housing is not part of the TOD in Dalian, China. With planned TOD communities, affluent homeowners who value amenities and pursue to live near transit most likely will still travel by car (Mu and Jong, 2012). Transit-Oriented Development is used in regional development as well in China. It is suitable for the development of new town. Where to start, at what pace, what development model to use are three of the many questions faced by local governments. Dayue Consulting (2014) summarized three common mistakes. First of all, the interaction and coordination between transportation infrastructure and land supply is not done well. For example, the government can sell too much land to developers very early, diminishing the value of the land. Take the Hexi new town in Nanjing for example. The government invested 30 billion Yuan to build infrastructure and public supporting projects in a new town over a four-year period starting from 2002. The land value was raised substantially. In 2005, the land price was once 2.4 million Yuan/acre. Although the improvement of transportation facilities and public supporting facilities caused

appreciation in the land value, the government only got 10.5 billion in the four years by selling 9149 acres of land. The income could not cover the cost at all. The reason was that in the beginning of the construction of the new town, the government sold over 3400 acres of land at a price lower than 0.8 million Yuan/acre. There was almost no land to sell after the land price soared. Secondly, the government only pays attention to the development of transit and forgets to regulate the land use around the stations. For example, many villas were built around Shanghai subway line 1. This discourages the use of public transportation and doesn't help traffic circulation. Thirdly, the integration of public transportation system is not done well. The construction of subway, BRT, bus, bike and walking system should be given priority. But in many cities, with the development of the city's economy, the roads are built wider and wider. Pedestrians don't have enough space and the design of transit stations is not very convenient.

On August 2014, the General Office of the State Council published the "opinion on supporting the implementation of integrated land and rail development". It requires that with the reform of financial and investment system of railway and demand to accelerate rail construction, the land for railway and adjacent land should be developed in an integrated way, which supports rail development and facilitates new urbanization. It clarifies policies in four aspects. First of all, revitalize the existing land for railway and promote integrated land development. Secondly, encourage the integrated development of new railway stations, properly define the boundary and size of the integrated development, and be clear about the planning requirement for rail station construction and integrated development. Thirdly, refine the supporting policy for integrated development such as land use index, land supply model and relevant project construction norms. Fourthly, enhance the supervision and coordination of integrated development, the related Land and Resources Department in the city and town should sign an Memorandum of Understanding with the major developer, making it clear that the railway and station projects should be done before the integrated development project (State Council Website, 2014). The CEO of Beijing Dayue Consulting Firm Yongxiang, Jin responded to this "opinion" that rail integrated development should serve the city, not the other way around (Caixin Website, 2014).

## **Implications for This Study**

Transit-Oriented Development concept aims to balance different land uses and utilize the benefits brought by public transportation. Successful TOD planning keeps building density compatible with transit, encourages walking and biking, and facilitates industry integration. In the US, infill development around transit stations in large cities like New York and Chicago make it really convenient for people to commute via transit. Scholars and practitioners promote TOD as an antidote to the suburban sprawl. It brings opportunities of affordable housing for those relying on transit. In China, the construction of HSR makes it easier to travel between cities. It is typical for cities to make plans about a new sub-center from scratch around HSR stations. Transit-Oriented Development is desirable because a large number of Chinese cities are facing serious congestion and environmental issues, and building infrastructure causes deficits to the government. The contexts of US and China are very different. When facing the challenges of TOD plan around HSR stations, there are not many US experiences for China to borrow.

## **DATA AND METHODOLOGY**

The analysis is built upon the plans, news and studies about the Jinan West Station District, interviews with planning professionals, public officials and apartment owners, site visits and some secondary data. The thesis uses evidence such as dropping housing prices and growing GDP to show the problems of TOD plans. It identified the mismatches in the plans and the goals, the conflict of auto-oriented design and transit-oriented design and access issues etc.. The financing and land use policy are problematic too, which is found in in-depth interview with public officials and planners. News and interviews provide perspectives of apartment buyers and developers who participated in the speculation. At last, proposals were made for TOD plans to work better around HSR stations in the future.

## GOALS OF JINAN WEST STATION DISTRICT TOD PLAN

### To Build A New Town

First of all, according to the 2010 population survey, Jinan has a residential population of 6.8M, and an urban population of 4.3M. The urbanization strategy set in 2003 is to build new towns in the east and west, find opportunities to grow in the north, control growth in the south and reduce functions and pressures of the central city. West Station District is expected to accommodate 3.5M residents. It will have many public service functions like schools, library and exhibition center.

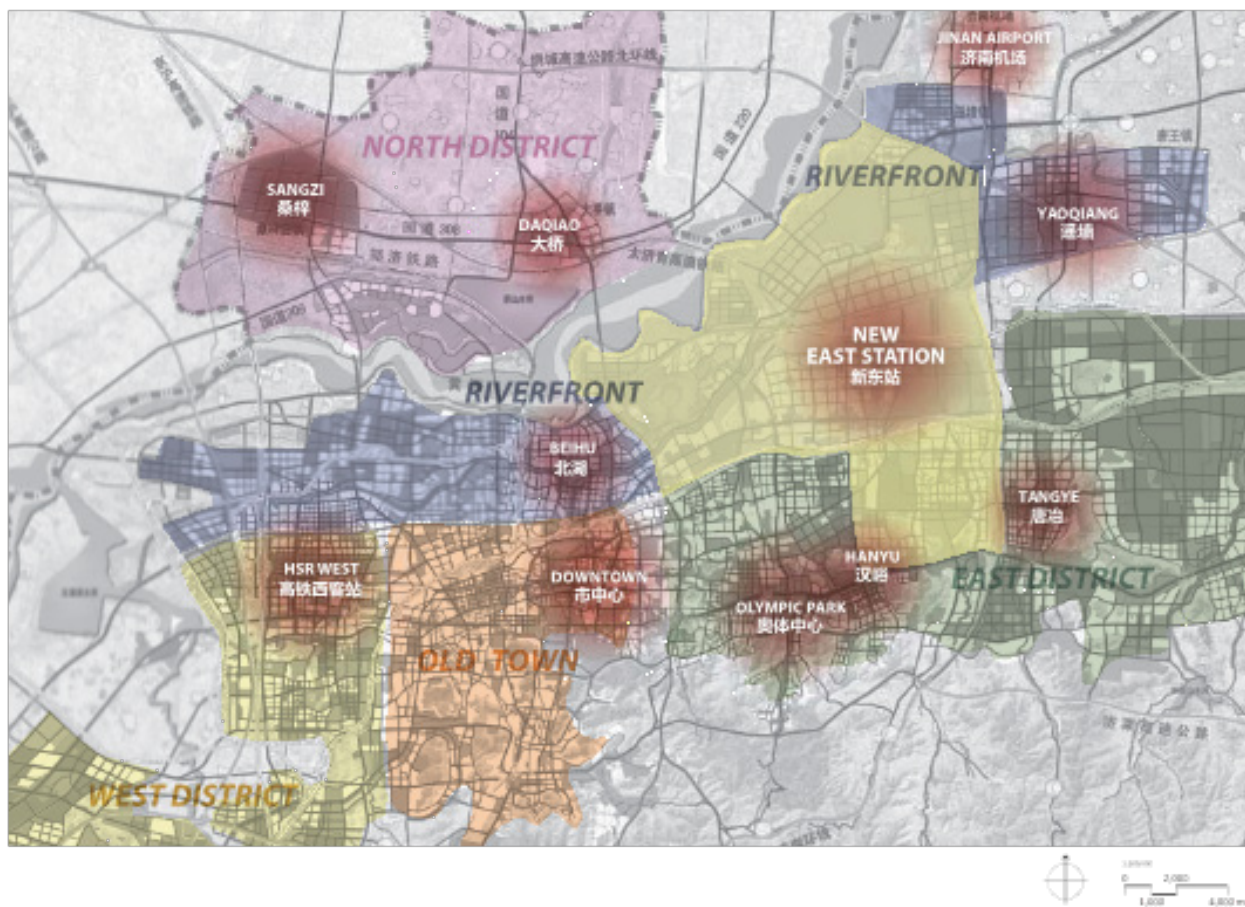


Figure 1 Location of Jinan West Station District

### To Seize Economic Opportunity

HSR is expected to bring great economic benefits. It shortens the travel time between Jinan and two economic centers Beijing and Shanghai. It also provided access to other major cities such as Nanjing, Tianjin and Suzhou, connecting metropolitan regions and promotes the development of the whole



country. It serves 68,000 daily passengers, contributing to the flow of skilled labor, information, capital and technology. The plans are aimed to maximize land value and make West Station District the core area and economic engine of the west part of Jinan. It is planned as the gateway of Shandong Province and the cultural, exhibition, business and transaction center of Jinan. Theoretically, the mix of land uses should satisfy most of the needs of residents and reduce auto trips (See Figure 2).

A CBD is planned within 5-10min walking distance to the station, which will attract companies from major economic centers (See Figure3). They are connected by attractive public open space. Further away from the CBD on the central axis, there is a public service center. The public service center consists of a grand theatre designed by Paul Andreu, a cultural complex by A As Architecture which is comprised of three major public buildings: the Visual Arts Centre, the library and the performing arts Centre (See Figure 4).



Figure 2 Land Use in Jinan West HSR District



Figure 3 5-10min Walking Distance from HSR Station

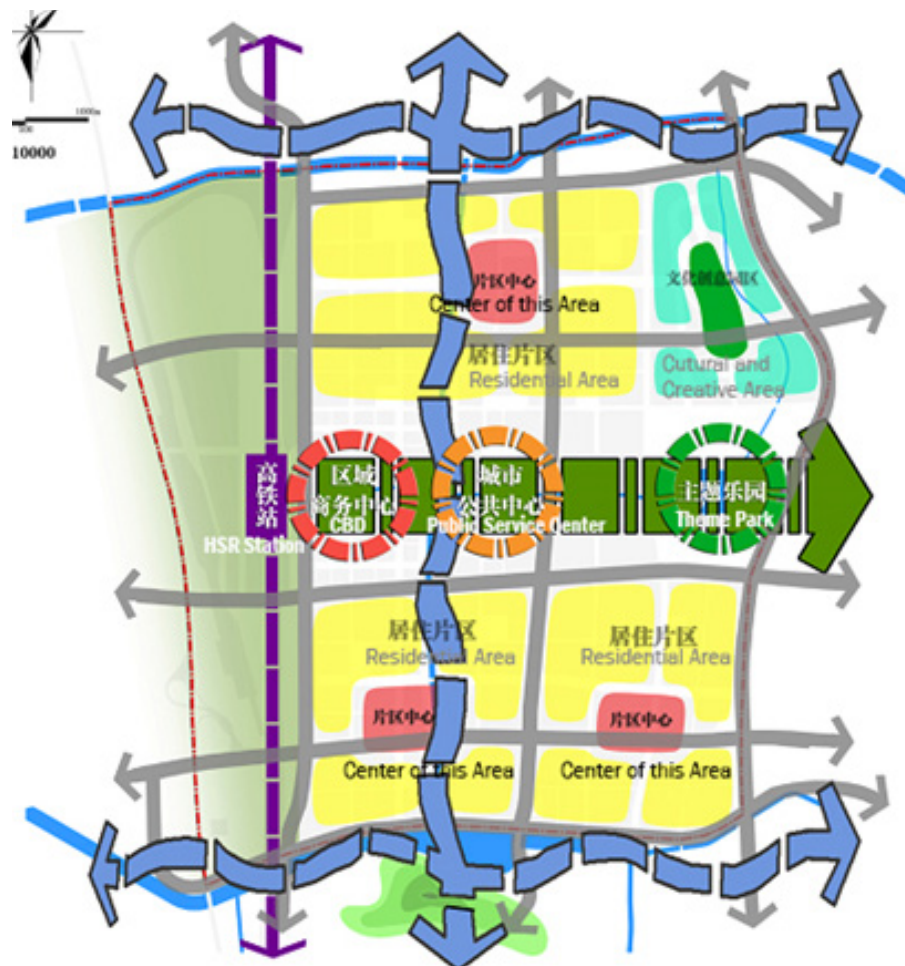


Figure 4 Planning Structure

## **To Encourage Walking and the Use of Transit**

Thirdly, Jinan has serious air pollution and congestion problems. The city has the determination to tackle these problems. Jinan is among the first public transit demonstration cities approved by the national transportation department in 2012. It emphasizes the service quality of public transit and gives a lot of priority to it. At the same time, nice walking environment and public space will be created to connect with public transit. For a long time, planners have been negotiating with developers for the urban design that promote walking and increase the use of public transit.

Pedestrian, bike, and routes are made explicit in the West Station District control plan, shown in Figure 5 and 6. The plan aims to create pedestrian friendly streets and increase walkability of the neighborhood. For example, on Weihai Road, pedestrian sidewalk and bike path will be combined with the open space in front of stores. On Qingdao Road, pedestrian sidewalk will be placed within the green boulevard. It requires the width of sidewalk should be no less than 1.5m (5ft) and the width of bike path should be no less than 3m (10ft). To make the boulevard successful, the plan also regulates the building function and form along Qingdao Road. Height for residential building should be lower than 100m and the floor area ratio (FAR) should be lower than 3.5. Height for public building should be lower than 140m and FAR should be lower than 5.0. Besides, buildings along Qingdao Road will have uniform appearance. Buildings near the street will not have podium. Residential open space should be allocated in the shown location. Public buildings near the core area will have ground floor retail, forming an enclosed commercial street. There will also be a visual corridor over 40m as shown in Figure 7.

In the Jinan West HSR Station plan, subway, buses and BRT networks will be integrated with the HSR. Figure 8 shows the alignment of metro line 1, 6, 7 and location of stations.





Figure 5 Pedestrian System Plan



Figure 6 Biking System Plan



Figure 7 Building Block Control along Qingdao Road

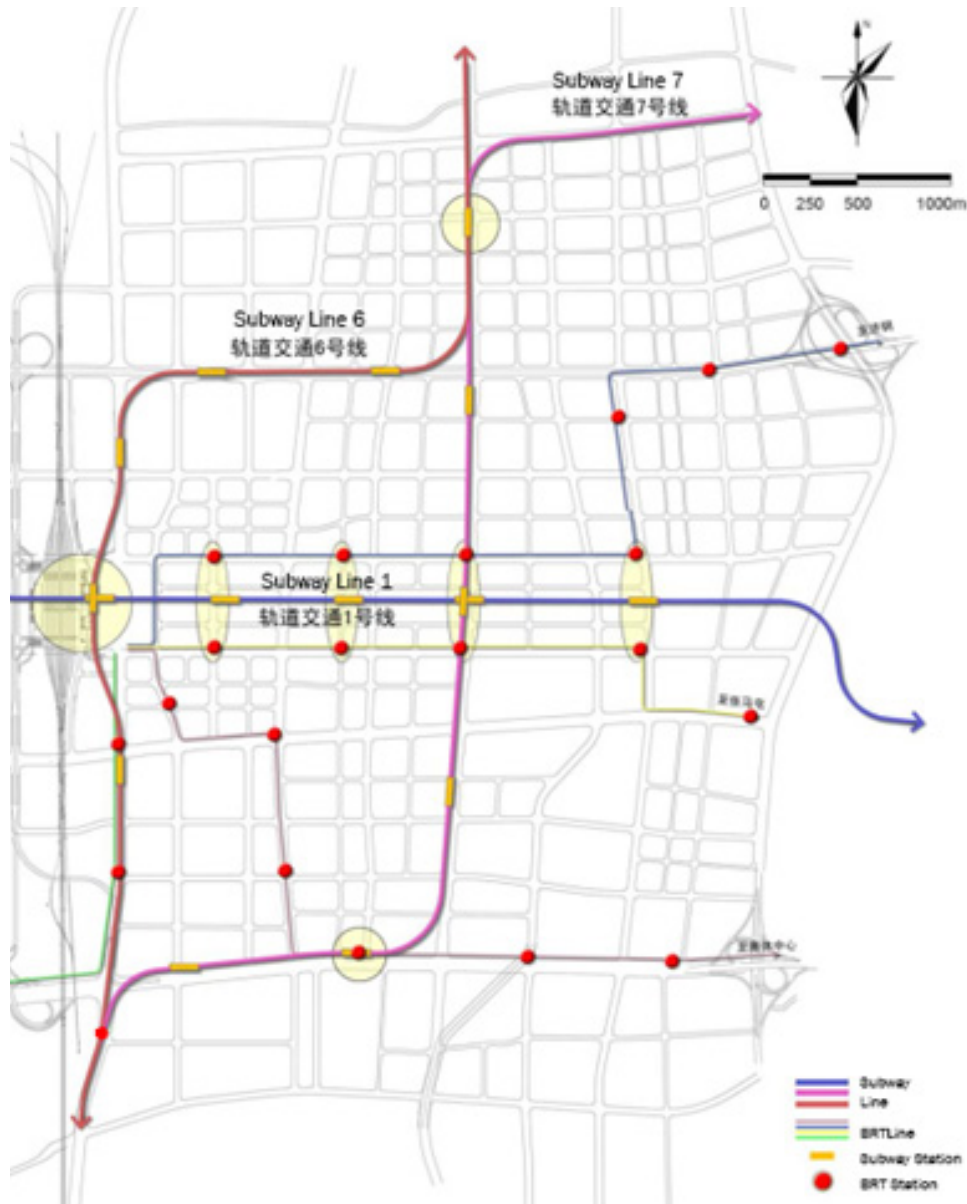


Figure 8 Subway and BRT Network

## PLANNING SEQUENCING

According to the West Station District Economic Plan, there are four stages for economic development: the take off stage, the growth stage, the development stage and the maturity stage (See Figure 9).

The construction of infrastructure began in 2009. HSR began operation in 2011. In June, 2011, two buildings of Lvdi Huadu with over 200 apartments were almost sold out on the first day. At that time, the sales in the west side of Jinan exceeded that in the central city and the east. The library,

performing arts center and grand theatre were opened in 2013 for the National Art Festival. By that time, more than half of the road network was completed. Out of the 141.29 km of roads planned in the long term, 82.05 km were built.

During the take off stage, the station plaza, roads, exhibition center, business transaction centers and office buildings were built, making the district ready for investment. Currently the West Station District is in the growth period, when the infrastructure in front of the Station is being improved gradually as well as hotels, restaurants, stores and offices. And the transaction center for land, real estate project bidding and intellectual property is built. The cultural, exhibition, business and transaction centers should be developed pretty well by the end of this period.

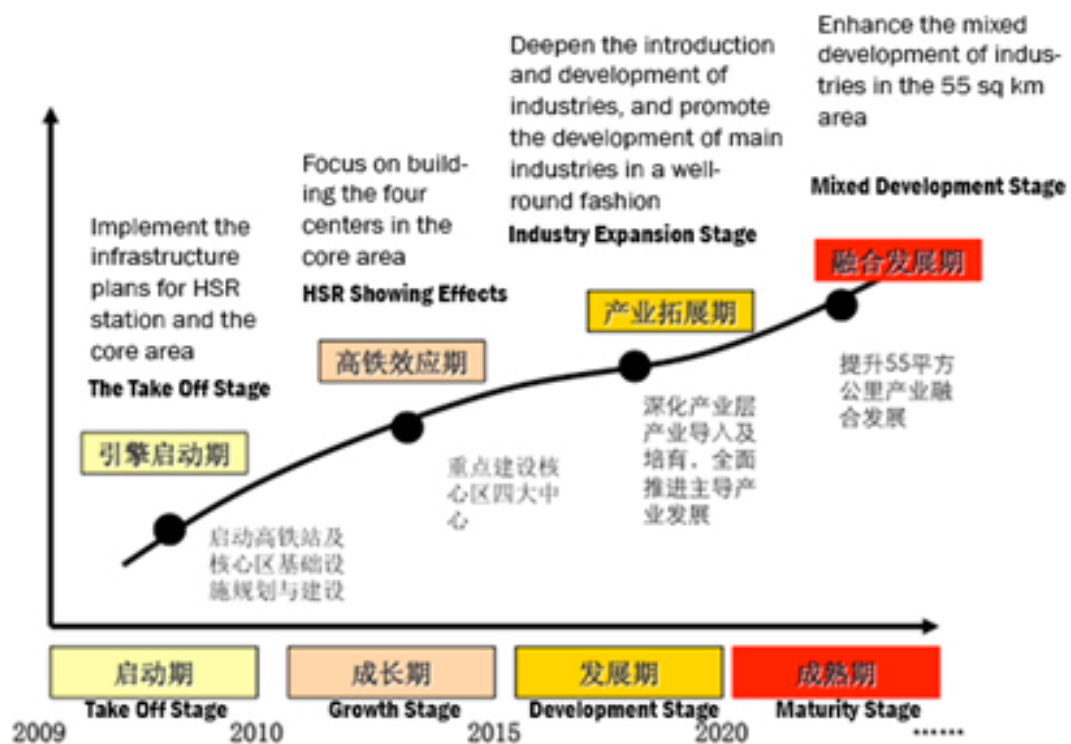


Figure 9 Stages of Economic Development

## PROBLEMS

### Growing GDP and Dropping Housing Prices

Jinan's economy has been growing at a fast pace over the last decade. Figure 10 shows the growth rate. In 2009, the National Game was held in the east side of Jinan. Jinan seized that opportunity to redevelop, improving the city's infrastructure and enhancing the city's appearance. Many first-tier real estate developers were attracted to Jinan from then on. Jinan's economy is still growing at over 8% in the Post National Game Era. The housing price in the east side new town was about 10,000 Yuan/ m<sup>2</sup> in 2009 (Qilu Evening Newspaper, 2009) and kept growing at a steady pace. People were curious if the west would catch up with the east. Analysts predicted that money would go to the west and raise the housing price there.

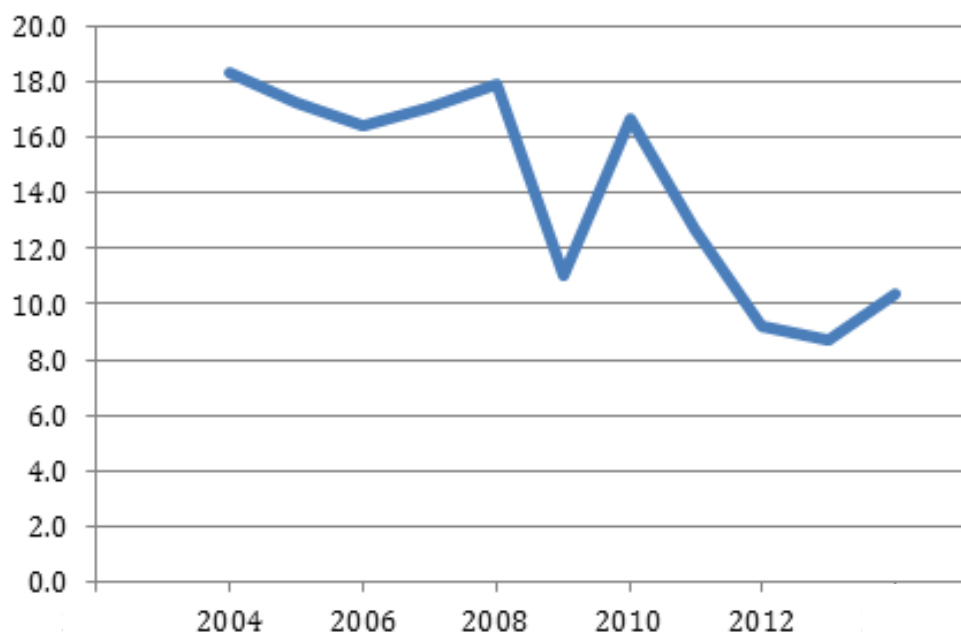
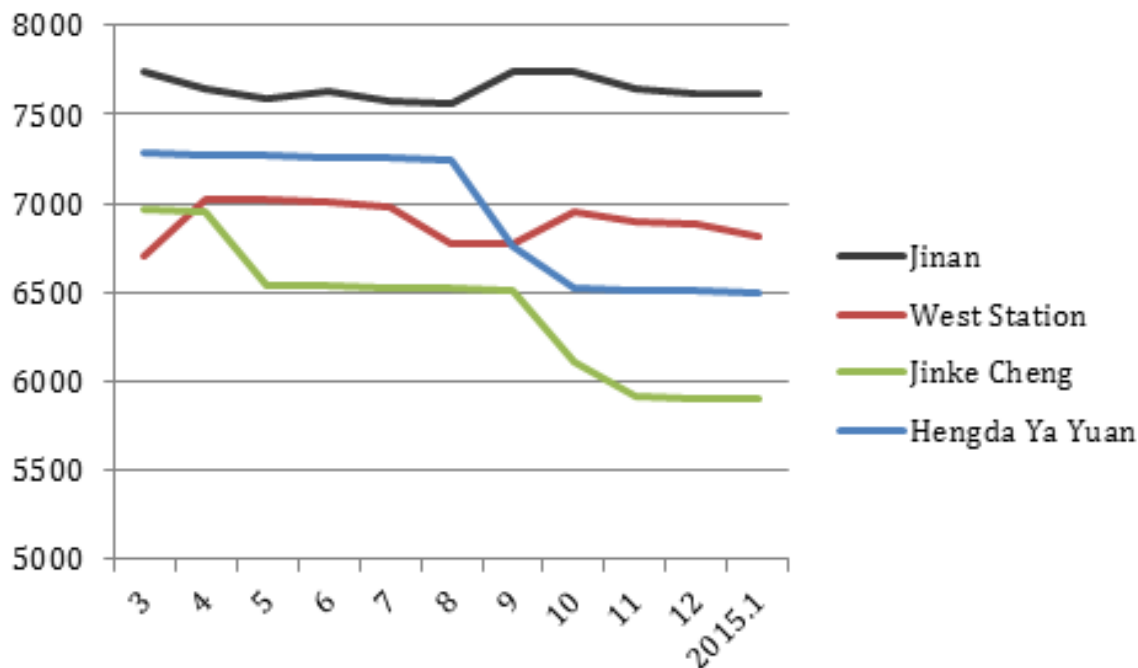


Figure 10 Jinan's Annual GDP Growth Rate from 2004 to 2014

In 2011, the average sales price of residential projects in the West Station District all went over 8000 Yuan/ m<sup>2</sup> (Dushi Nvbao Newspaper, 2011). But from March 2014 to January 2015, average housing prices of the 17 projects on sale in the West Station District fluctuated between 6500 Yuan/ m<sup>2</sup> and 7000 Yuan/ m<sup>2</sup> (See Figure 11). It was below the average housing price of the city, which was between 7500 Yuan/ m<sup>2</sup> and 8000 Yuan/ m<sup>2</sup>. The other two lines on this chart shows the drop

of housing prices of two housing projects situated in front of the station and was on sale very early: Jinke Cheng and Hengda Ya Yuan.

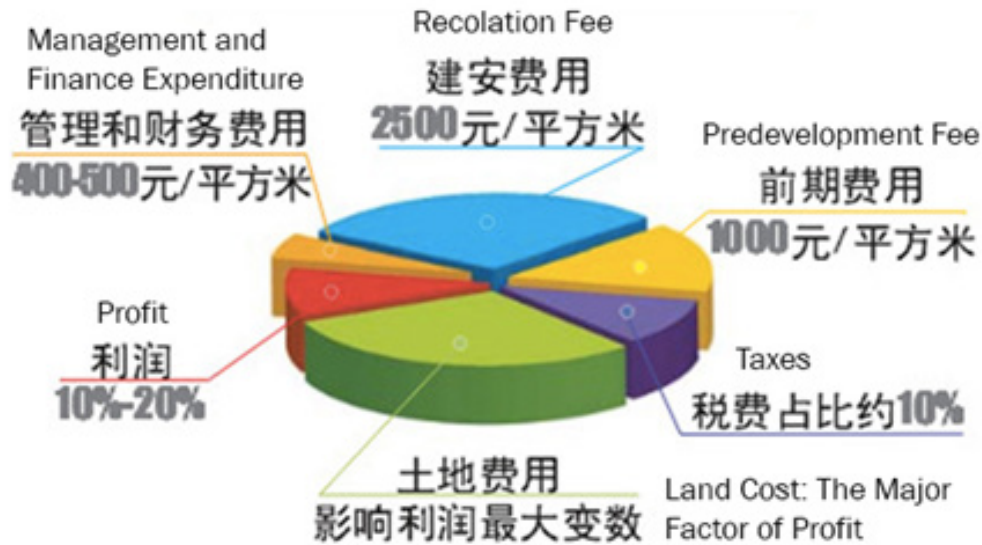


(Source: www.anjuke.com)

Figure 11 Housing Prices of Jinan, West Station District and Two Building Projects in the West Station District (Adjusted for inflation in 2015)

Now developers are selling apartments at a low price with little profit. The development cost is about 6000 Yuan/ m<sup>2</sup>. So if the price dropped lower than that, developers could not make any profit. Housing price consists of five major components (See Figure 12). Relocation fee for high rise apartments is 2500 Yuan/m<sup>2</sup>. Management including promotion fee and wages plus interests paid to bank, trust and companies is 400-500 Yuan/m<sup>2</sup>. Predevelopment fee is 1000 Yuan/m<sup>2</sup> while tax accounts for 10% of the housing price which include sales tax and land appreciation tax. Profit takes up 10% to 20% of the housing price and is highly dependent on the cost of land. If the developer gets the land at 4 million Yuan/Mu, the cost is 2000 Yuan/m<sup>2</sup> (Life Daily Newspaper, 2014). Apart from some very early deals, most land was sold at 3 million Yuan/Mu to 4 million Yuan/Mu. So the cost varies from 5000 Yuan/m<sup>2</sup> to 6000 Yuan/m<sup>2</sup> (Life Daily Newspaper, 2014).





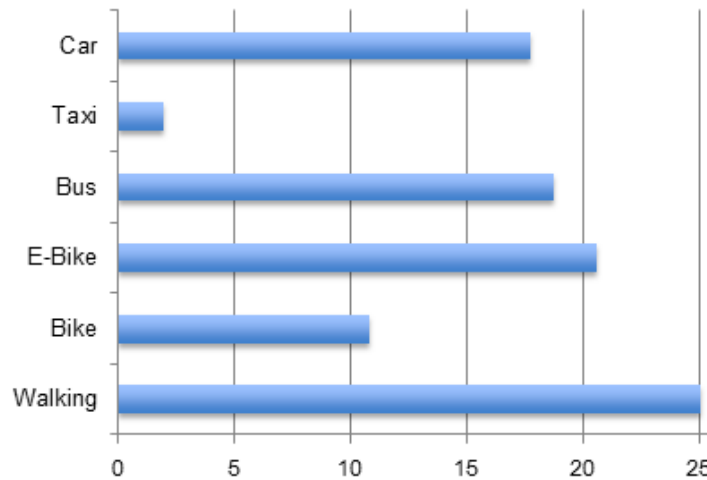
(Source: Life Daily Newspaper, 2014)

Figure 12 Basic Composition of Housing Prices

### Inconvenient Public Transportation

Only five bus lines are in operation: : K156, K157, K109, K58 and K167. The bus network density is 0.8km/km<sup>2</sup>. It is unclear when the subway and BRT will be built. They concentrate in the relocation area. The repetitive index is 1.58 because most of them go to the HSR station and the relocation area. Most lines have low peak hour occupancy and the nonlinearity index is greater than 1.4. The Station is 10 km away from the city center, about 1 hour by bus (Shandong University Transportation Center, 2013).

Figure 13 shows that in 2013, only 25 percent of people travel by car and taxi in Jinan during peak hours. 19 percent of people take the bus, 40 percent use bike or E-bike and 25 percent walk. It would be very inconvenient for most people to live in the West Station District and commute to the city center to work. They have to both work and live in the West Station District.



(Source: 2013 Jinan Comprehensive Transportation Survey)

Figure 13 Travel Mode Share during Peak Hour in Jinan

### **Low-income Tenants and Absence of Retail and Schools**

Development of schools and retail actually fall behind the development of the residential projects. Absence of large supermarket, lack of restaurants and schools bother people who want to move in. Many companies are also forced to postpone moving in, because employees will face similar issues. For a long time, the only people living in the planned West Station District are relocated villagers even though thousands of apartments are sold. Tenants have much lower income compared to those living in new town on the east side. Taxi drivers don't like to go to the west side mainly for this reason. Picking up passengers from the station requires a long waiting time.

Visitors who come to the exhibition center and the grand theatre take their own food, or they have to buy food from street vendors (Jinan Daily Newspaper, 2014). There are no kindergarten and schools except for a boarding high school.

### **Urban Design that Discourages Walking**

Another problem is that the urban design mainly serves automobiles and can discourage walking. First of all, residential superblocks are created. The average spacing between roads is 304.78m. A lot of density is surrounded by the walls of the residential projects. People who don't live there cannot use the local roads in these superblocks and need to travel extra miles in order to get to the transit stations.



The road network in the West Station District has a grid pattern, which means that roads don't converge to the railway station and subway stations. The planned road network consists of 20 horizontal roads and 17 vertical roads, as is shown in Table 1. In the long-term plan, Road network density of the West Station District will be 6.56km/km<sup>2</sup> which is higher than 4.35 km/km<sup>2</sup> in the city center area.

Table 1 Road Network Planned and Built in 2013

	Number of Roads	Typology	Mileage (km)			
			Arterial	Collector	Local	Total
Built	37	20 horizontal and 17 vertical	37.36	32.17	12.52	82.05
Planned	56	29 horizontal and 27 vertical	38.86	45.46	56.97	141.29

(Source: 2013 Jinan Comprehensive Transportation Survey)

Secondly, a lot of parking is provided for cars both in the public service center and the residential land use. A parking intensity plan was made in accordance with development density, shown in Figure 14. The CBD and public service center are expected to generate large amount of vehicular traffic. The parking density is over 400 parking spaces per 10,000 m<sup>2</sup>. For 9 residential building projects on sale, 0.8 to 1 parking is provided per unit (See Table 2). This is pretty high and doesn't encourage the use of public transit.

Table 2 Parking per Household of Residential Projects

Projects	Housing Prices (Yuan/m <sup>2</sup> )	Units	Parking Space/ Unit
1	7100	2411	0.9
2	7100	501	0.9
3	6980	710	0.8
4	6980	2751	0.8
5	6498	3984	1
6	6800	6500	0.8
7	6088	2371	0.8
8	6400	1211	0.8
9	5180	3002	1

(Source: www.anjuke.com)

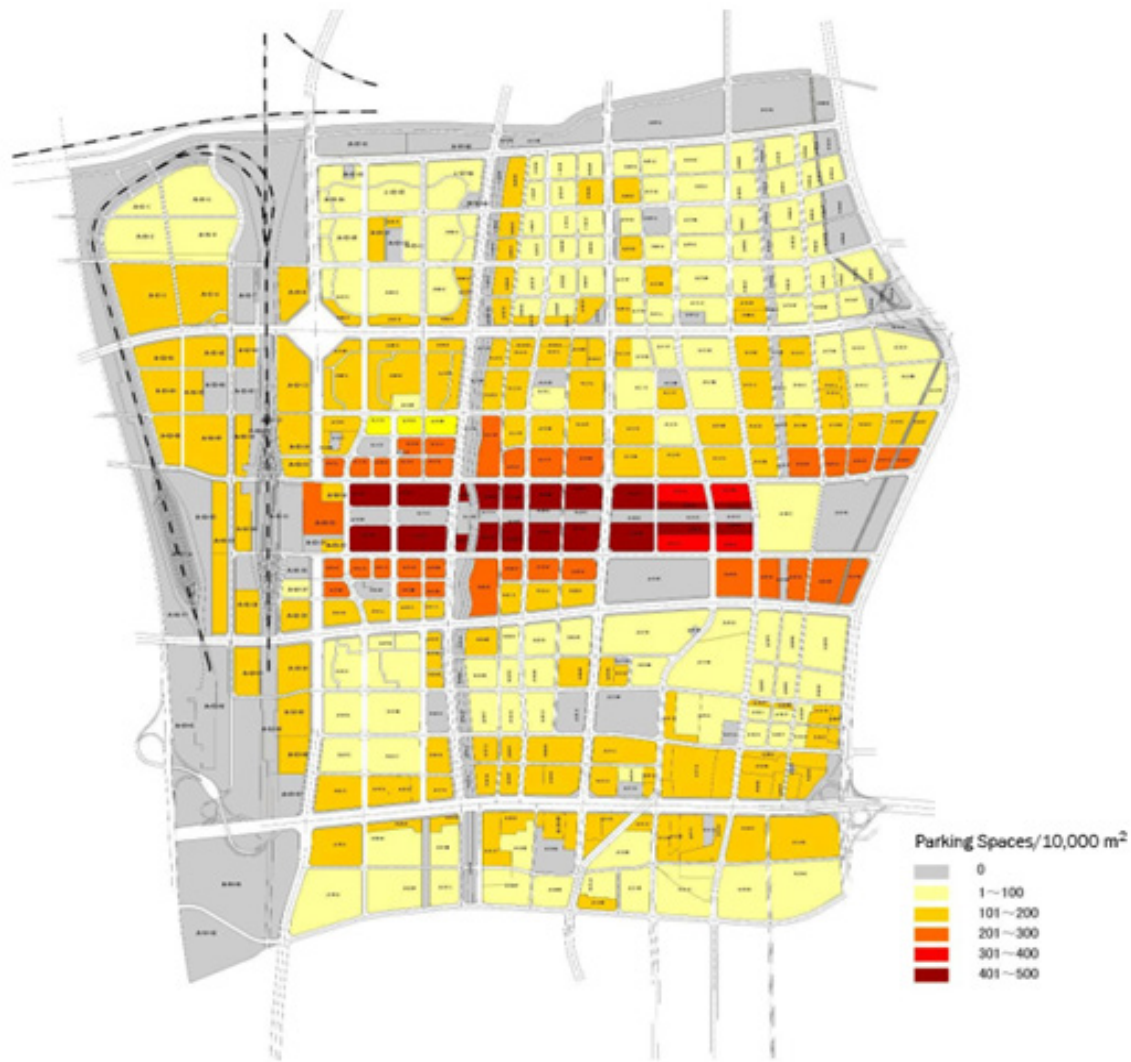


Figure 14 Parking Intensity Plan for West HSR District

Thirdly, the access to the HSR station is mainly by car. There is a ramp connected to the second level of the station, which is dangerous to walk on (See Figure 15). The pedestrian plaza in front of the station is not frequently used. At night, no light poles provide lighting for the plaza including the part leading to the bus station. This environment is unsafe for pedestrians and transit users (See Figure 16).

In a word, these design features for automobility undermine TOD by discouraging walking and the use of public transit.



Figure 15 Jinan HSR Station Looking South



Figure 16 Jinan HSR Station Looking South at Night

## REASONS

### Speculation

One of the underlying reasons why the TOD plans are struggling is speculation. Table 3 shows that the housing price of a project near the HSR and planned subway station is not much higher than the one also on the west side but away from the HSR station. The benefits of HSR were exaggerated and caused speculation. The prices were high when HSR opened because people saw it as an investment opportunity as there are successful precedents in other countries. An apartment owner of Hengda Yayuan told the author that he bought the apartment as an investment years ago, hoping the West Station District would prosper like the real estate along High-Speed Rail in Japan. It is in fact the mentality of most homebuyers. Many people in Jinan are looking for investment opportunities. Some are investing in cities around Jinan with the opening of HSR, because of the limited investment opportunity in Jinan (Jinan Daily Newspaper, 2011).

Table 3 Comparison of Projects near Subway Line in and out of the West Station District

		Units	Parking Space	FAR	Existing Bus Line	Distance to Planned Subway Line 1	In the West Station District
Lvdi Huadu	5180	3002	3002	2.6	61,175,172	200m	Yes
Zhongjian Changqing Lake	4950	7258	7258	2.0	2, 14	300m	No

(Source: [www.anjuke.com](http://www.anjuke.com))

When the construction of the West Station District began, it put the government on a clock to pay back the loan to the bank for predevelopment and relocation. In order to write the debt off the balance sheet, the government sold the land to developers at a very low price. Developers raced to buy land because of the huge potential brought by HSR. They advertised the investment value of the property. In a flyer for the apartment on sale, the proximity to subway and stores is also highlighted, but with a note saying that the developers cannot promise these will be built as planned. The oversupply of

land caused oversupply of apartments and contributed to the drop in housing prices.

### **Not for Daily Commute**

Next, HSR provides poor access because people can't use HSR for daily commute. It is true that it takes only one and a half hour to travel to Beijing, and three and a half hour to travel to Shanghai by HSR if the train skips some stops. However, there is an extra travel time when people get out of the HSR station in major cities before they reach their final destinations. Table 4 illustrates the extra and total travel time from Jinan West Station to Beijing, Shanghai and Nanjing's CBD districts. The total travel time from Jinan West HSR Station to the CBD in Shanghai is over 4 hours by subway and 4 hours by car. And it is over 3 hours to the CBD in Nanjing by subway and almost 3 hours by car. Consequently, it is very unlikely for one to travel to Shanghai and Nanjing and get back within the same day to attend a conference or to run other errands. It is worth noting that the extra travel time by car doesn't take into account the serious congestion in the major cities so the actual total travel time can be much longer.

Extra time ratio is defined as the ratio of extra travel time over total travel time. It is the extent to which the total travel time is affected by the traffic condition in the destination cities. Extra travel time ratio by subway is 0.4 in Beijing compared to 0.2 in Shanghai and Nanjing mainly due to the design and alignment of the subway. Furthermore, if people want to go to other areas other than the CBD which are further away from the HSR station, traveling by car may be faster. As a result, the office buildings in the West Station District are not so attractive to companies.

The plan assumes that it will be convenient for companies located in the CBD in front of the West HSR Station to do business in other major cities, and that large and profitable companies will be attracted to Jinan. But in reality the companies that have planned to move in so far are from smaller cities within the province.

Table 4 Travel Time from Jinan West HSR Station to CBD in Major Cities

Origin (Railway Station)	Destination (CBD)	HSR Travel Time (h)	Subway			Car		
			Extra Travel Time (min)	TotalTravel Time	Extra Travel Time Ratio	Extra Travel Time (min)	TotalTravel Time	Extra Travel Time Ratio
Beijing South	CCTV Headquater	1.5	60	2h 30min	0.40	21	1h 51min	0.19
Shanghai Hongq- iao	Lujiazui, Pudong	3.5	47	4h 17min	0.18	28	4h	0.12
Nanjing South	Xinjiekou	2.5	45	3h 15min	0.23	19	2h 49min	0.11

(Source: Google Map)

### Land Use Policy

Next, there are policy obstacles for mixed land use. The land use category affects the tax and utility charges (water, gas, electricity etc.). According to Code for Classification of Urban Land Use and Planning Standards of Development Land GB 50137-2011, there is no mixed-use category (See Table 5), except that ground floor retail can be provided in the residential land use. There is no mixed-use category for office and retail. People living in houses in the administration and public services land cannot enjoy school district service and cannot get the local Hukou. Developers don't want to buy commercial space even if it is the same price as residential space.

Table 5 Urban Development Land Categories

Codes	Land Use
R	Residential
A	Administration and public services
B	Commercial and business facilities
M	Industrial
W	Logistics and warehouse
S	Street and transportation
U	Municipal utilities
G	Green space



## **Closed-off Management**

The reason for residential superblocks is closed-off management. There is security check for each neighborhood. Entrance pass is needed. Developers often refuse to break up the superblock and provide retail for the public on the first floor for security reasons. It is also related to Chinese people's traditional lifestyle and mindset.

In 1990s, closed-off management was as an evaluation standard for the “demonstration neighborhood”. From 1990 to 2000, over 83% of neighborhoods in Shanghai were closed off using different methods. During the same period, 54,000 neighborhoods were turned into gated communities in Guangdong Province, covering over 70% of urban area and over 80% population (Calthorpe, P., Yang, B., et al., 2014).

## **PROPOSALS**

First of all, the government could consider tap into the money and management skills of private side through public and private partnership. Public and private partnership enables collaboration between government and private developers starting from the feasibility study stage of infrastructure construction. Usually a company is created for a particular project and then government and the private investors are both responsible for the project and benefit from the infrastructure through this company. The key is risk allocation and requires trust when the government is choosing the private partner. Since a new town takes about 5 to 10 years to form, the land should be put into the market at different stages as the district develops. In that way, the government could captured the rising land value.

Secondly, the land use should respond to the need of tourists and residents. Compared with Shanghai Hongqiao Station, the variety of retail is significantly lacking. The ridership is about 20,000 a day, but people don't stay to shop. The plan just put the CBD in front of the station, but people may come here for the cultural events or other things. A larger number and variety of retail should be provided according to the demand.

Thirdly, the government should figure out regulations that encourage mixed land use. Currently cities improvise when formulating the control plan to allow for more flexibility. Jinan has a mixed-use category whose ownership is 50 years, which is between 70 years of residential buildings and 40 years of commercial buildings. Similarly, Beijing's F category land use allows more mixed use.

Fourthly, the planning sequencing could be done differently. For one thing, construction of the HSR station predated the development of the West Station District. If the resident projects got built first, developers would want to build retails. This could attract high-income tenants when the HSR opens. Also the construction of subway and BRT could be better coordinated with the HSR, which will significantly contribute to the integration of the West Station District and the city center's economy.

Last, urban design could be improved to provide a safe and pleasant environment for pedestrians and transit users. To open up the gated community, the government could take on more management responsibility by converting the roads in the community into city roads. Roads in the community should be managed by municipal administration and traffic police, listed as one of the land transfer conditions. The existing superblocks can be broken up into smaller blocks too.

## **CONCLUSIONS**

Transit-Oriented Development concept is used in developing new towns around HSR stations in China. But the development lacks coordination, causing problems at least in the short term. The high housing prices have not been maintained during a period when the economy is growing. And the hope that the housing around HSR station is going to be used is diminished by institutional speculation. The thesis discovered many underlying reasons for the struggling TOD plans. The benefits of HSR is overestimated, it doesn't improve daily access. Before high capacity and high-speed transit connect the new town with the old city, it is challenging to integrate the new town with the city economy. There are also many management and policy issues involved in creating new urbanism neighborhoods and making TOD plans. It is important



to address the relation between transportation and land use correctly.

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